What is claimed is:

1. An inner rotor hybrid stepping motor of 6-phase and 6m-pole type, comprising:

a stator comprising an annular magnetic substance, 6m pieces of stator magnetic poles that are centripetally formed around the inner circumferential surface of said annular magnetic substance toward the center at equal pitches and each stator magnetic pole having a plurality of pole teeth formed on the inner tip end thereof at equal pitches, and excitation windings being wound around said stator magnetic poles;

a rotor, which is rotatably supported by said stator through a predetermined air gap with respect to the inner circumferential surface of said stator pole teeth, having a cylindrical permanent magnet magnetized in an axial direction that is sandwiched between a pair of rotor magnetic poles each having rotor pole teeth corresponding to said stator pole teeth;

wherein said stator magnetic poles include first magnetic poles whose pole teeth formed on the inner tip ends are line-symmetric with respect to the shape of said magnetic poles and second magnetic poles whose pole teeth are formed on the inner tip ends at the same pitches and the same number as said pole teeth of said first magnetic poles and said pole teeth of the second magnetic poles are deviated from the pole teeth of said first magnetic poles by 1/4 pitch in the same

circumferential direction, said first and second magnetic poles are alternatively arranged in the circumferential direction, and said stator containing said first and second magnetic poles is divided into a first stator portion and a second stator portion that are arranged in the axial direction, and said first and second magnetic poles of said first stator portion are connected to said second and first magnetic poles of said second stator portion, respectively, in the axial direction, while said first and second stator portions are inverted in the front and back in the circumferential direction;

wherein said rotor includes first and second rotor units that face the inner circumferential surfaces of pole teeth of said first and second stator portions with said air gap, each of said first and second rotor units is provided with a permanent magnet magnetized in the axial direction that is sandwiched between coaxial first and second rotor magnetic poles, said first and second rotor magnetic poles have rotor pole teeth around the outer circumferential surface thereof, the number of said rotor pole teeth corresponds to that of said stator pole teeth, said first rotor magnetic pole is deviated from said second rotor magnetic pole by 1/2 of the rotor teeth pitch, and said first and second rotor units are connected in the axial direction through a non-magnetic material member such that they are deviated from each other by 1/4 of the rotor teeth

pitch;

and wherein the number of said rotor pole teeth Z satisfies the following condition;

$$Z = m(6n + 1) \text{ or } Z = m(6n + 2)$$

where m and n are integers equal to or larger than 1.

2. An inner rotor hybrid stepping motor of 10-phase and 10m-pole type, comprising:

a stator comprising an annular magnetic substance, 10m pieces of stator magnetic poles that are centripetally formed around the inner circumferential surface of said annular magnetic substance toward the center at equal pitches and each stator magnetic pole having a plurality of pole teeth formed on the inner tip end thereof at equal pitches, and excitation windings being wound around said stator magnetic poles;

a rotor, which is rotatably supported by said stator through a predetermined air gap with respect to the inner circumferential surface of said stator pole teeth, having a cylindrical permanent magnet magnetized in an axial direction that is sandwiched between a pair of rotor magnetic poles each having rotor pole teeth corresponding to said stator pole teeth;

wherein said stator magnetic poles include first magnetic poles whose pole teeth formed on the inner tip ends are line-symmetric with respect to the shape of said magnetic

poles and second magnetic poles whose pole teeth are formed on the inner tip ends at the same pitches and the same number as said pole teeth of said first magnetic poles and said pole teeth of the second magnetic poles are deviated from the pole teeth of said first magnetic poles by 1/4 pitch in the same circumferential direction, said first and second magnetic poles are alternatively arranged in the circumferential direction, and said stator containing said first and second magnetic poles is divided into a first stator portion and a second stator portion that are arranged in the axial direction, and said first and second magnetic poles of said first stator portion are connected to said second and first magnetic poles of said second stator portion, respectively, in the axial direction, while said first and second stator portions are inverted in the front and back in the circumferential direction;

wherein said rotor includes first and second rotor units that face the inner circumferential surfaces of pole teeth of said first and second stator portions with said air gap, each of said first and second rotor units is provided with a permanent magnet magnetized in the axial direction that is sandwiched between coaxial first and second rotor magnetic poles, said first and second rotor magnetic poles have rotor pole teeth around the outer circumferential surface thereof, the number of said rotor pole teeth corresponds to that of said

stator pole teeth, said first rotor magnetic pole is deviated from said second rotor magnetic pole by 1/2 of the rotor teeth pitch, and said first and second rotor units are connected in the axial direction through a non-magnetic material member such that they are deviated from each other by 1/4 of the rotor teeth pitch;

and wherein the number of said rotor pole teeth Z satisfies the following condition;

$$Z = m(10n + 2) \text{ or } Z = m(10n + 3)$$

where m and n are integers equal to or larger than 1.

3. An outer rotor hybrid stepping motor of 6-phase and 6m-pole type, comprising:

a stator comprising a cylindrical magnetic substance, 6m pieces of stator magnetic poles that are radially formed around the outer circumferential surface of said cylindrical magnetic substance at equal pitches and each stator magnetic pole having a plurality of pole teeth formed on the outer tip end thereof at equal pitches, and excitation windings being wound around said stator magnetic poles;

a rotor, which is rotatably supported by said stator through a predetermined air gap with respect to the outer circumferential surface of said stator pole teeth, having a cylindrical permanent magnet magnetized in an axial direction that is sandwiched between a pair of rotor magnetic poles each

having rotor pole teeth corresponding to said stator pole teeth;

wherein said stator magnetic poles include first magnetic poles whose pole teeth formed on the outer tip ends are line-symmetric with respect to the shape of said magnetic poles and second magnetic poles whose pole teeth are formed on the outer tip ends at the same pitches and the same number as said pole teeth of said first magnetic poles and said pole teeth of the second magnetic poles are deviated from the pole teeth of said first magnetic poles by 1/4 pitch in the same circumferential direction, said first and second magnetic poles are alternatively arranged in the circumferential direction, and said stator containing said first and second magnetic poles is divided into a first stator portion and a second stator portion that are arranged in the axial direction, and said first and second magnetic poles of said first stator portion are connected to said second and first magnetic poles of said second stator portion, respectively, in the axial direction, while said first and second stator portions are inverted in the front and back in the circumferential direction;

wherein said rotor includes first and second rotor units that face the outer circumferential surfaces of pole teeth of said first and second stator portions with said air gap, each of said first and second rotor units is provided with a

permanent magnet magnetized in the axial direction that is sandwiched between coaxial first and second rotor magnetic poles, said first and second rotor magnetic poles have rotor pole teeth around the inner circumferential surface thereof, the number of said rotor pole teeth corresponds to that of said stator pole teeth, said first rotor magnetic pole is deviated from said second rotor magnetic pole by 1/2 of the rotor teeth pitch, and said first and second rotor units are connected in the axial direction through a non-magnetic material member such that they are deviated from each other by 1/4 of the rotor teeth pitch;

and wherein the number of said rotor pole teeth Z satisfies the following condition;

$$Z = m(6n + 1) \text{ or } Z = m(6n + 2)$$

where m and n are integers equal to or larger than 1.

4. An outer rotor hybrid stepping motor of 10-phase and 10m-pole type, comprising:

a stator comprising a cylindrical magnetic substance, 10m pieces of stator magnetic poles that are radially formed around the outer circumferential surface of said cylindrical magnetic substance at equal pitches and each stator magnetic pole having a plurality of pole teeth formed on the outer tip end thereof at equal pitches, and excitation windings being wound around said stator magnetic poles;

a rotor, which is rotatably supported by said stator through a predetermined air gap with respect to the outer circumferential surface of said stator pole teeth, having a cylindrical permanent magnet magnetized in an axial direction that is sandwiched between a pair of rotor magnetic poles each having rotor pole teeth corresponding to said stator pole teeth;

wherein said stator magnetic poles include first magnetic poles whose pole teeth formed on the outer tip ends are line-symmetric with respect to the shape of said magnetic poles and second magnetic poles whose pole teeth are formed on the outer tip ends at the same pitches and the same number as said pole teeth of said first magnetic poles and said pole teeth of the second magnetic poles are deviated from the pole teeth of said first magnetic poles by 1/4 pitch in the same circumferential direction, said first and second magnetic poles are alternatively arranged in the circumferential direction, and said stator containing said first and second magnetic poles is divided into a first stator portion and a second stator portion that are arranged in the axial direction, and said first and second magnetic poles of said first stator portion are connected to said second and first magnetic poles of said second stator portion, respectively, in the axial direction, while said first and second stator portions are inverted in the front and back in the circumferential

direction;

wherein said rotor includes first and second rotor units that face the outer circumferential surfaces of pole teeth of said first and second stator portions with said air gap, each of said first and second rotor units is provided with a permanent magnet magnetized in the axial direction that is sandwiched between coaxial first and second rotor magnetic poles, said first and second rotor magnetic poles have rotor pole teeth around the inner circumferential surface thereof, the number of said rotor pole teeth corresponds to that of said stator pole teeth, said first rotor magnetic pole is deviated from said second rotor magnetic pole by 1/2 of the rotor teeth pitch, and said first and second rotor units are connected in the axial direction through a non-magnetic material member such that they are deviated from each other by 1/4 of the rotor teeth pitch;

and wherein the number of said rotor pole teeth Z satisfies the following condition;

$$Z = m(10n + 2) \text{ or } Z = m(10n + 3)$$

where m and n are integers equal to or larger than 1.

5. The inner rotor or outer rotor hybrid stepping motor according to one of claims 1 through 4, wherein each stator comprises:

a predetermined number of stacked magnetic material

plates each of which has h/2 pieces of magnetic poles whose pole teeth formed on the tip ends are line-symmetric with respect to the shape of said magnetic poles of a predetermined size and h/2 pieces of magnetic poles whose pole teeth are deviated by 1/4 of the pole teeth pitch in the same circumferential direction that are alternatively arranged;

a predetermined number of stacked magnetic material plates having the same constructions as said magnetic material plates that are rotated by 180/h degrees, said stacked elements are fixed to each other; and

windings that are wound around said magnetic poles, where h equals 6m or 10m and m is an integer equals to or larger than 1.

6. The inner rotor or outer rotor hybrid stepping motor according to one of claims 1 through 5, wherein said stator pole teeth pitch τS and said rotor pole teeth pitch τR satisfy the following condition:

$$0.75\tau R \leq \tau S \leq 1.25\tau R$$